Orion Vehicle Mount Weather Station™

User Manual

Version 1.02

All specifications subject to change without notice.

Printed in U. S. A.

© Copyright 2006 Columbia Weather Systems, Inc. All Rights Reserved.

Proprietary Notice: Orion, Orion 510, Orion Vehicle Mount, Capricorn 2000, Capricorn 2000MP and Capricorn 2000EX are trademarks of Columbia Weather Systems, Inc. The information and drawings contained herein are the sole property of Columbia Weather Systems, Inc. Use of this publication is reserved exclusively for customers of Columbia Weather Systems, Inc. and their personnel. Reproduction of this material is forbidden without the express written consent of Columbia Weather Systems, Inc.

Parts of the Orion Vehicle Mount Weather Station™ user manual were adapted from the Weather Transmitter WXT510 User's Guide with permission from Vaisala Oyj.

WINDCAP®, RAINCAP®, HUMICAP®, BAROCAP® and THERMOCAP® are registered trademarks of Vaisala.

Welcome!

Welcome to the Columbia Weather Systems family of users and congratulations on your purchase of the Orion Weather Station.

The Orion Vehicle Mount Weather Station is quite easy to install and you may be tempted to skip the installation procedure or other portions of this manual. We recommend that you resist that urge. A thorough knowledge of these installation and calibration procedures will greatly increase the usefulness and the accuracy of your instrument. In particular, a proper installation will help prevent problems with both operation and maintenance.

Please read this manual completely prior to installation.

Important Notice: Shipping Damage

BEFORE YOU READ ANY FURTHER, please inspect all system components for obvious shipping damage. The Orion 510 is a high precision instrument and can be damaged by rough handling. Your unit was packaged to minimize the possibility of damage in transit. Therefore, we recommend that you save the shipping container for any future shipment of your Orion unit.

In the event your order arrives in damaged condition, it is important that the following steps be taken immediately. The title transfers automatically to you, the customer, once the material is entrusted to the transport company.

NOTE: DO NOT RETURN THE INSTRUMENT TO COLUMBIA WEATHER SYSTEMS until the following steps are completed. Failure to follow this request will jeopardize your claim.

1. Open the container and inspect the contents. Do not throw away the container or any damaged parts. Try to keep items in the same condition as originally received.
2. Notify the transport company immediately in writing, preferably by facsimile, about the shipping damage.
3. Wait for the transport company's representative to inspect the shipment personally.
4. After inspection, request permission from Columbia Weather Systems for return of the damaged instrument by calling the Service Department, (503) 629-0887.
5. Return approved items to us at the following address:

   Columbia Weather Systems, Inc.

   2240 NE Griffin Oaks Street, Suite 100

   Hillsboro, OR 97124
6. After return authorization is issued and we receive the instrument, an estimate of the cost of repair will be sent to you for submittal to the transport company as a claim.

ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. However, it is possible to damage the product by delivering electrostatic discharges when touching, removing, or inserting any objects inside the equipment housing.

To make sure you are not delivering high static voltages yourself:

1. Handle ESD sensitive components on a properly grounded and protected ESD workbench. When this is not possible, ground yourself with a wrist strap and a resistive connection cord to the equipment chassis before touching the boards. When neither of the above is possible, at least touch a conductive part of the equipment chassis with your other hand before touching the boards.
2. Always hold the boards by the edges and avoid touching the component contacts.

Table of Contents

WELCOME! 3

IMPORTANT NOTICE: SHIPPING DAMAGE 5

ESD PROTECTION 6

SECTION 1: INTRODUCTION 11

THE ORION WEATHER STATION 11
Features: *11*
SPECIFICATIONS 12
Temperature *12*
Barometric Pressure *12*
Wind Speed *12*
Wind Direction *12*
Relative Humidity *12*
Rainfall *13*
Input Voltage *13*
Heating Power Source *13*
PRINCIPLES OF MEASUREMENTS 14
Wind Measurement *14*
Barometric Pressure, Temperature, and Relative Humidity (PTU) Module *15*
Rainfall Measurement *16*

SECTION 2: PHYSICAL DESCRIPTION 17

ORION 510 SENSOR TRANSMITTER 17
Sensor Transmitter Components *17*
Mounting Adapter *19*
Internal Terminal Block *19*
Heating (Optional) *21*
Orion Interface Module *22*
ORION DATA MANAGER SOFTWARE 23
Orion Data Manager Installation and Configuration *23*
WEATHERMASTER 2000™ SOFTWARE (OPTIONAL) 25
WEATHER DISPLAY CONSOLE (OPTIONAL) 26

SECTION 3: INSTALLATION 27

SYSTEM CONFIGURATION 27
INSTALLATION OVERVIEW 27
UNPACKING THE UNIT 28
INSTALLING THE TELESCOPING MAST AND VEHICLE-MOUNT BRACKETS 29
INSTALLING THE VEHICLE MOUNT SENSOR CONNECTOR AND ROUTING CABLE 30
INSTALLING THE INTERFACE MODULE 30

CONNECTING THE WEATHER DISPLAY CONSOLE AND COMPUTER 31
INSTALLING THE SENSOR TRANSMITTER AND NORTH ORIENTATION 32
Installing the Mounting Adapter *32*
North Alignment *33*

SECTION 4: OPERATION 35

COMMUNICATION SETTINGS 35
WEATHER SOFTWARE 35
TERMINAL COMMANDS 35
Displaying current sensor readings *35*
CONTINUOUS DISPLAY OF WEATHER INFORMATION 36

SECTION 5: CALIBRATION 39

CALIBRATING THE BAROMETRIC PRESSURE SENSOR 39
Altitude Setting *39*
Optional Calibration Procedure *39*
CALIBRATING THE TEMPERATURE SENSORS 40

SECTION 6: MAINTENANCE 41

CLEANING 41
REPLACING THE PTU MODULE 41
FACTORY CALIBRATION AND REPAIR SERVICE 42

SECTION 7: TROUBLESHOOTING 43

SECTION 8: USER SUPPORT INFORMATION 45

LIMITED WARRANTY 45
EXCLUSIONS *45*
RETURN FOR REPAIR PROCEDURE 46

REFERENCE 49

GLOSSARY 49
Aspirating Radiation Shield *49*
Barometric Pressure *49*
Celsius Temperature Scale *49*
Dew Point *49*
Fahrenheit Temperature Scale *49*
Heat Index *49*
Relative Humidity *50*
Sea Level Pressure *50*
Wind Chill *50*
UNIT CONVERSION 51
Speed *51*
Temperature *51*
Distance *51*

Pressure *51*
TABLES AND FORMULAS 52
Wind Chill Chart *52*
Wind Chill Equation *52*
Heat Index *53*
Dew Point *54*

SECTION 1: INTRODUCTION

The Orion Weather Station

Utilizing cutting-edged ultrasonic technology at an amazingly affordable price, the Orion Weather Station is the newest product in our family of innovative weather monitoring systems.

Orion provides ultrasonic wind direction and speed measurements, a highly-accurate impact rain sensor, capacitive relative humidity, temperature and barometric pressure readings – all in a single sensor module.

High accuracy and fine resolution make this new system ideal for precision weather monitoring. Orion's sensors meet FAA and WMO specifications for aviation operations, as well as EPA requirements for scientific environmental monitoring applications.

Features:

- Six most essential weather parameters measured in one instrument
- Accurate and stable measurement
- Ultrasonic wind sensor and impact precipitation sensor
- No moving parts means virtually no maintenance
- Optional LCD touch-screen display console and powerful software
- Low power consumption improves reliability and longevity
- Compact and lightweight with a single cable for quick installation
- 9-ft telescoping mast with truck mount quick release hardware

Specifications

Temperature

Range: -60 to 140°F (-52 to +60°C)

Accuracy: ±-0.5°F (±0.3°C) at 68°F (+20°C)

Resolution: 0.1°F (0.1°C)

Units Available: °F, °C

Barometric Pressure

Range: 17.50 to 32.50 InHg (600 to 1100 mbar)

Accuracy: ±0.015 InHg (0.5 mbar) at +32 to 86°F
(0 to 30°C)

±0.03 InHg (1 mbar) at -60 to 140°F (-52 to 60°C)

Resolution: 0.01 InHg (0.1 mbar)

Units Available: Kpa, mbar, InHg

Wind Speed

Range: 0 - 115 mph (0 - 60 m/s)

Accuracy: ±0.7 mph (±0.3 m/s)

Resolution: 1 mph (1 m/s)

Units Available: knots, mph, km/hr, m/s

Wind Direction

Azimuth: 0 - 360°

Accuracy: ±2°

Resolution: 1°

Relative Humidity

Range: 0 - 100%RH

Accuracy: ±3%RH (0-90%), ±5% (90-100%)

Resolution: 1%RH

Units Available: %RH

Rainfall

Range: cumulative

Collection Area: 60 cm2

Accuracy: ±5% (spatial variations may exist)

Resolution 0.01 in. (0.254mm)

Units Available: mm, inches

Input Voltage

The Orion is supplied with a wall mount transformer

Input: 120 VAC, 60 HZ, 16 W

Output: 12 VDC, 800 mA

The Orion can also be powered directly using a DC voltage source

Input: 5 to 30 VDC (60 mA at 12 VDC)

Heating Power Source

Input: 5 to 30 VDC (1.1 A at 12 VDC)

Principles of Measurements

Wind Measurement

Both wind speed and direction are measured using advanced ultrasonic technology. The sensor utilizes ultrasound to determine horizontal wind readings. The array of three equally-spaced ultrasonic transducers on a horizontal plane is an ideal design that ensures accurate wind measurement from all directions, without blind angles or corrupted readings.

The wind sensor has no moving parts, which makes it virtually maintenance free.

The wind sensor has an array of three equally spaced ultrasonic transducers on a horizontal plane. Wind speed and wind directions are determined by measuring the time it takes the ultrasound to travel from each transducer to the other two.

The wind sensor measures the transit time (in both directions) along the three paths established by the array of transducers. This transit time depends on the wind speed along the ultrasonic path. For zero wind speed, both the forward and reverse transit times are the same. With wind along the sound path, the up-wind direction transit time increases and the down-wind transit time decreases.

The wind speed is calculated from the measured transit times using the following formula:

$V_w = 0.5 \times L \times (1/ t_f - 1/tr$

where:

V_w = Wind speed

L = Distance between the two transducers

t_f = Transit time in forward direction

t_r = Transit time in reverse direction

Measuring the six transit times allows V_w to be computed for each of the three ultrasonic paths. The computed wind speeds are independent of altitude, temperature and humidity, which are cancelled out when the transit times are measured in both directions, although the individual transit times depend on these parameters.

Using V_w values of two array paths is enough to compute wind speed and wind direction. A signal processing technique is used so that wind speed and wind direction are calculated from the two array paths of best quality.

The wind speed is represented as a scalar speed in selected units (m/s, kt, mph, km/h). The wind direction is expressed in degrees (°). The wind direction reported indicates the direction that the wind comes from. North is represented as 0°, east as 90°, south as 180°, and west as 270°.

The wind direction is not calculated when the wind speed drops below 0.05 m/s. In this case, the last calculated direction output remains until the wind speed increases again to the level of 0.05 m/s.

The average values of wind speed and direction are calculated as a scalar average of all samples over the selected averaging time (1 ... 900 s). The sample count is based on a 4 Hz sampling rate. The minimum and maximum values of wind speed and direction represent the corresponding extremes during the averaging time.

Barometric Pressure, Temperature, and Relative Humidity (PTU) Module

Barometric pressure, temperature, and humidity measurements are combined in an advanced sensor module (PTU) utilizing a capacitive measurement method for each parameter. The PTU module contains separate sensors for pressure, temperature, and humidity measurement.

The measurement principle of the pressure, temperature, and humidity sensors is based on an advanced RC oscillator and two reference capacitors against which the capacitance of the sensors is continuously measured. The microprocessor of the transmitter performs compensation for the temperature dependency of the pressure and humidity sensors.

Barometric pressure is measured using a capacitive silicon BAROCAP® sensor. The sensor has minimal hysteresis and excellent repeatability, as well as outstanding temperature and long-term stability.

Temperature is measured with a capacitive ceramic THERMOCAP® sensor.

Relative humidity measurement is based on a capacitive thin film polymer HUMICAP®180 sensor. The sensor is highly accurate with negligible hysteresis and excellent long-term stability in a wide range of environments.

Radiation Shield: This module is mounted in a specially-designed radiation shield which protects the sensors from both scattered and direct sunlight and precipitation. The composite material in the plates offers excellent thermal characteristics and UV stabilized construction. The white outer surface reflects radiation, while the black inside absorbs accumulated heat.

The internal sensor module is easily replaceable and readily available as a spare component. To order a replacement module, please use catalog no. 9581.

Rainfall Measurement

Rainfall is measured with an impact sensor, which detects the size and impact of individual rain drops. The signals resulting from the impacts are proportional to the volume of the drops. Hence, the signal from each drop can be converted directly to the accumulated rainfall.

This measurement method eliminates flooding and clogging, as well as wetting and evaporation losses.

The sensor transmitter uses RAINCAP® sensor 2 technology in precipitation measurement.

The precipitation sensor comprises of a steel cover and a piezoelectrical sensor mounted on the bottom surface of the cover.

The precipitation sensor detects the impact of individual raindrops. The signals from the impact are proportional to the volume of the drops. Hence, the signal of each drop can be converted directly to accumulated rainfall. Advanced noise filtering technique is used to filter out signals originating from other sources than raindrops.

The measured parameter is accumulated rainfall. Detection of each individual drop enables computing of rain amount with high resolution.

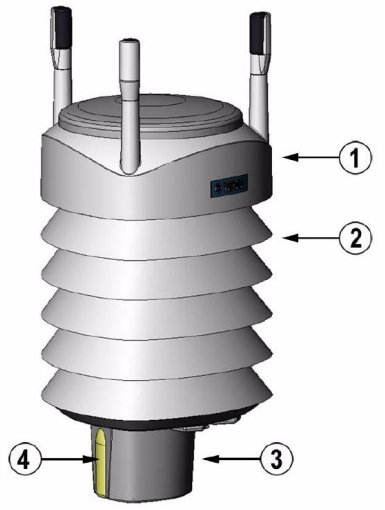
SECTION 2: PHYSICAL DESCRIPTION

Orion 510 Sensor Transmitter

The Orion 510 Sensor Transmitter is an all-in-one sensor unit containing ultrasonic wind speed and direction sensor, temperature sensor, relative humidity sensor, barometric pressure sensor and an impact rain sensor.

The temperature, relative humidity and barometric pressure sensors are combined in a single module housed in a self-aspirating radiation shield.

Sensor Transmitter Components

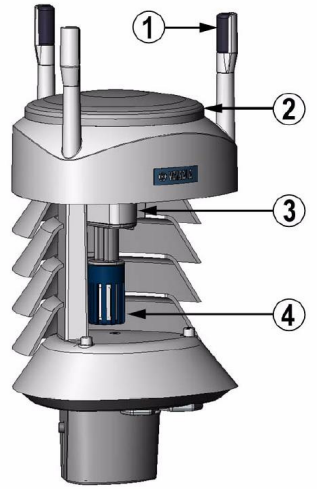


1: Top of the transmitter

2: Radiation Shield

3: Bottom of the transmitter

4: Screw conver



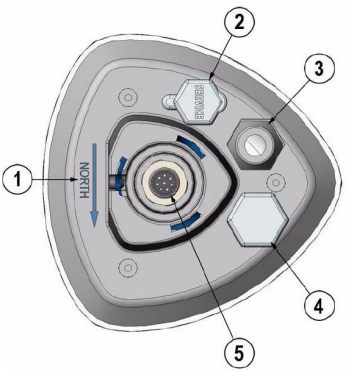
Cut Away View

1: Wind Transducers (3 pcs)

2: Precipitation Sensor

3: Pressure sensor inside the Sensor Module

4: Humidity and temperature sensor inside the Sensor Module



Bottom of the Transmitter

1: Alignment direction sign

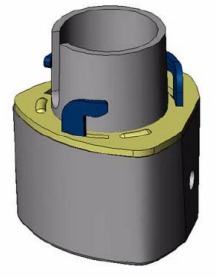
2: Service port

3: Water tight cable gland

4: Unused cable gland, covered

5: Connector (not available with Orion)

Mounting Adapter

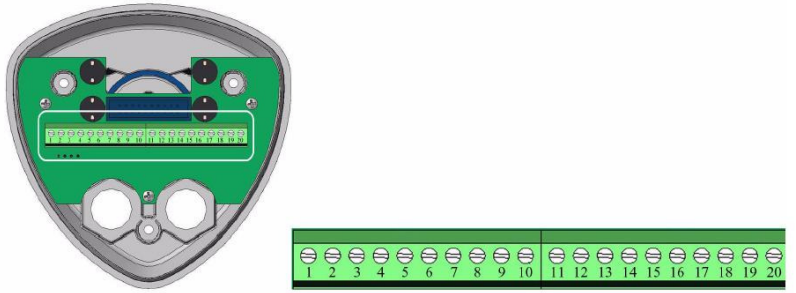


To facilitate easy installation and north alignment, the Orion 510 Sensor Transmitter comes standard with a mounting adapter. The mounting adapter is easily connected on the end of the mast and the sensor transmitter simply snaps into it. The north alignment needs to be performed only once.

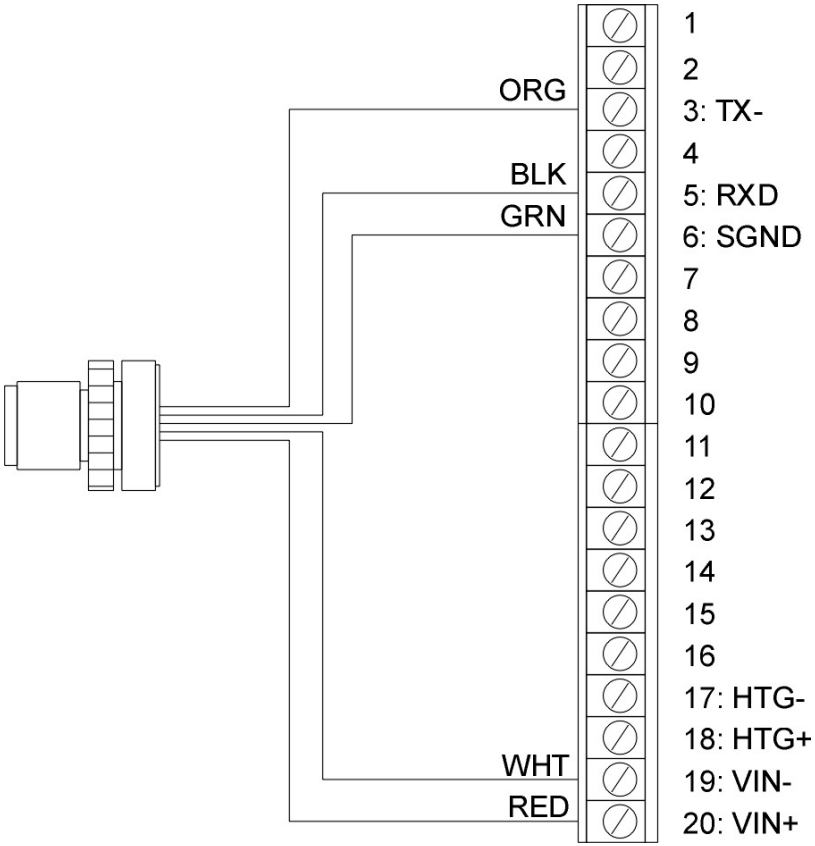
Internal Terminal Block

The sensor transmitter is shipped with a one (1) foot cable terminated by an 8-pin connector half.

This cable is connected to the sensor transmitter via a terminal block.



The Orion sensor transmitter has a standard RS-232 wiring as shown bellow:



Terminal Number	Signal	Color
3	TX-	Orange
5	RXD	Black
6	SGND	Green
19	VIN-	White
20	VIN+	Red

For heated sensor transmitters, terminal 17 (HTG-) is connected to the Blue wire and terminal 18 (HTG+) is connected to the Brown wire.

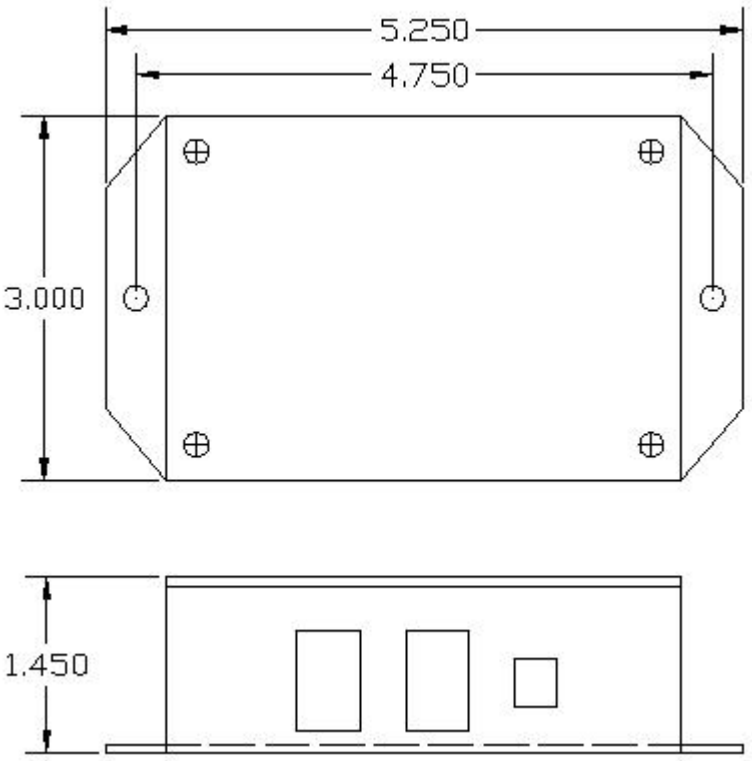
Heating (Optional)

Heating elements located below the precipitation sensor and inside the wind transducers keeps the precipitation and wind sensors free from snow and ice. A heating temperature sensor (T_h) underneath the precipitation sensor controls the heating.

Three fixed temperature limits, namely +3 °C, -2 °C, and -4 °C (+37 °F, +38 °F, +25 °F) control the heating power as follows:

T_h > +3 °C	heating is off
-2 °C < T_h < +3 °C	50% heating power
-4 °C < T_h < -2 °C	100% heating power
T_h < -4 °C	50% heating power

Orion Interface Module



The Orion Interface Module is used to supply power to the sensor transmitter and to provide two RS-232 communication ports. The RS-232 ports can be connected to computers, display consoles, transceivers, and other such devices.

Orion Data Manager Software

The Orion Data Manager Software is a virtual Control Module that communicates with the Sensor Transmitter, collects and processes the sensor data and makes it available to over a virtual serial port for other weather software packages such as WeatherMaster 2000 or any terminal programs such as Hyper Terminal.

The Orion Data Manager is only needed if a software viewing option is required. The Data Manager is not needed with the Weather Display Console.

Orion Data Manager Installation and Configuration

1. Insert the software CD into drive.
2. Wait for the Autorun to start the installation or run setup.exe.
3. Follow the instructions on the screen to finish the installation.
4. When the installation is finished, the Orion Data Manager will automatically start.

Click OK

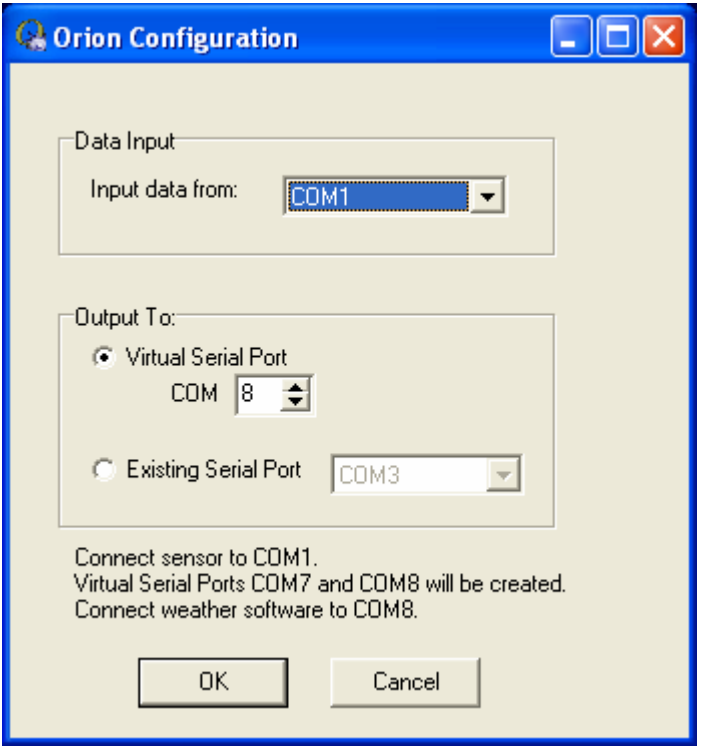
5. In the System Tray, you will see the Orion Data Manager icon.

Right click on the icon to display the menu items.

Start Orion Data Manager
Stop Orion Data Manager
Configure…
Exit

Select Configure…

6. Orion Data Manager Configuration Dialog:

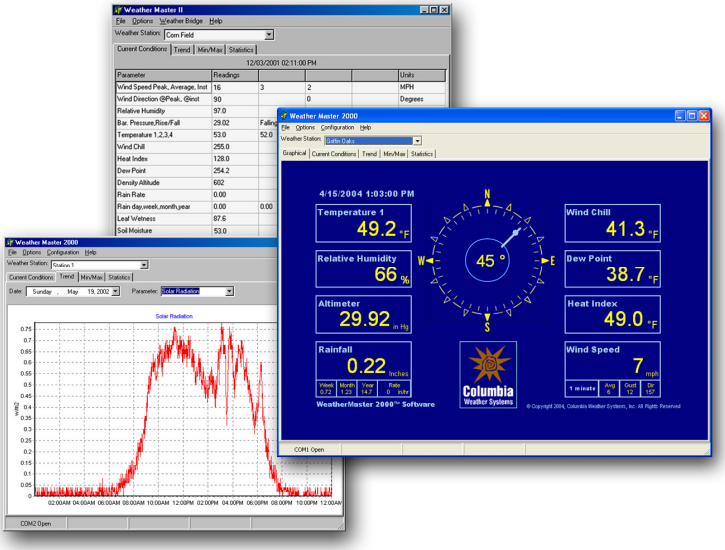


Select the COM port for the input data from the Sensor Transmitter.

Usually the Sensor Transmitter is connected to COM1, but in newer notebook computers, a serial port (COM1) is not available. To get a serial port, use a USB to serial converter or a serial port computer card. The USB to serial converters are usually installed on COM 4 or COM 5.

7. Select the Output Port. The default port is COM 8. Change the default port if it is used by another program or if the weather software does not go up to COM 8.
8. Click OK to close the Configuration dialog.
9. Install WeatherMaster software or other compatible weather software and configure it to use COM 8. Or you can use Hyper Terminal on COM 8.

WeatherMaster 2000™ Software (Optional)



WeatherMaster 2000 is a professional grade weather monitoring software. This software package is designed for specialized markets that require robust weather calculations, interoperability with computer models, and data interfaces to other industrial systems. WeatherMaster 2000 utilizes Microsoft Access database for easy data access and manipulation.

Please refer to the WeatherMaster 2000 user manual for more information.

Weather Display Console (Optional)

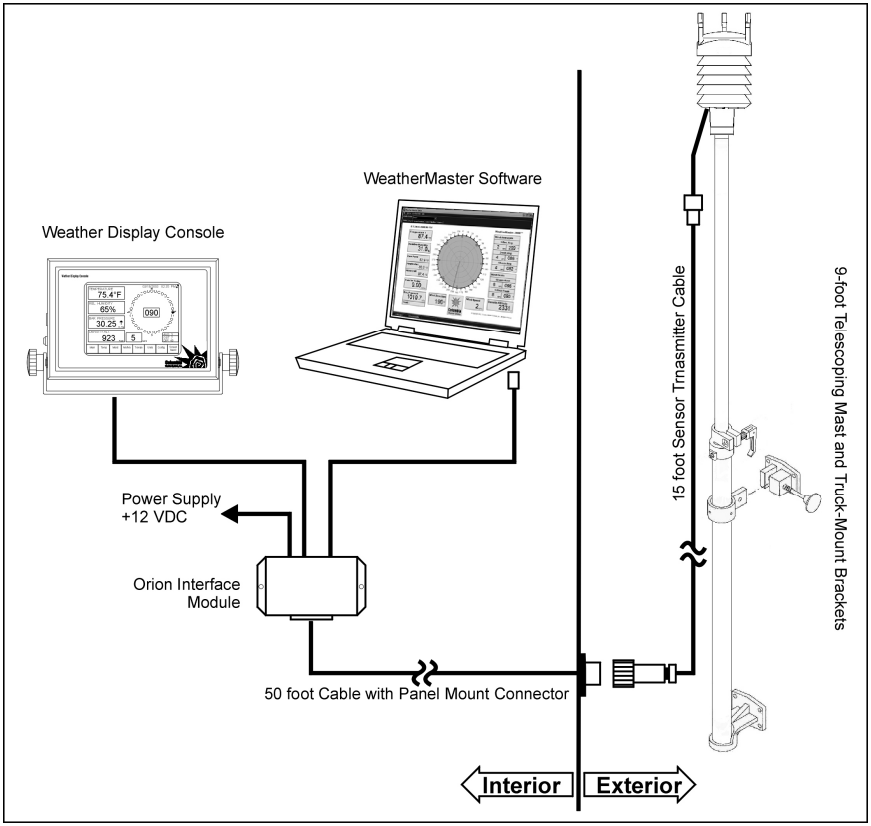
The Weather Display uses “intelligent” touch-screen technology. With its programmable microprocessor and abundant memory, the Capricorn 2000 Weather Display can display weather information, perform complex computations, and store relatively large amounts of weather data.

The Weather Display is also available in a 19” rack-mount chassis and a panel-mount configuration.

Please refer to the Weather Display Console user manual for more information.

SECTION 3: INSTALLATION

System Configuration



Installation Overview

Unpacking the Unit

Installing the telescoping mast and truck-mount brackets

Installing the vehicle mount connector and routing cable

Installing the Interface Module

Installing and connecting the Weather Display Console and Computer Software

Installing the Orion sensor transmitter and Quick-North Orientation

Unpacking the Unit

The sensor transmitter comes in a custom shipping container. Be careful when removing the device.

CAUTION: Beware of damaging any of the wind transducers located at the top of the three prongs. Dropping the device can break or damage the transducers. If any the prongs bends, twists, or becomes mis-aligned, re-aligning the sensor can be difficult or impossible.

Unpack the Orion weather station and verify that all parts are included.

1. Standard system includes:
    - ❑ Orion WXT510 Sensor Transmitter
    - ❑ 15 ft external sensor cable and male sensor connector (plus additional cable lengths, if ordered)
    - ❑ 50 ft internal cable with vehicle mount female sensor connector (plus additional cable lengths, if ordered) and all-weather connector cap
    - ❑ Orion Interface Module
    - ❑ (2) 3-positon terminal block connectors
    - ❑ Interface module power supply
    - ❑ Orion Data Manager Software
    - ❑ User Manual
    - ❑ 6-foot RS-232 cable (plus additional cable lengths, if ordered)
    - ❑ 9 ft telescoping mast with vehicle-mount brackets
    - ❑ Mast extension sleeve adapter
2. Weather Display Console (Optional)
    - ❑ Display Console
    - ❑ Power supply
    - ❑ 6-foot RS-232 cable (plus additional cable lengths, if ordered)
    - ❑ User Manual
3. WeatherMaster Software, with User Manual (Optional)

Inspect all system components for obvious shipping damage (Refer to “Important Notice: Shipping Damage” in case of damage).

Save the shipping carton and packing material in case the unit needs to be returned to the factory. If the system does not operate or calibrate properly, see Section 6: Maintenance and Section 7: Troubleshooting, for further instructions.

Installing the telescoping mast and vehicle-mount brackets

1. Select a location on the vehicle where the Orion sensor mast will be installed.
2. There are three mounting brackets that come with the mast. Two of the brackets will be permanently mounted to the vehicle for quick and easy set up. These mounting brackets consist of one mounting base plate and one spring-loaded securing mounting bracket. The third bracket is attached to the mast and mates with the slot on the spring-loaded mounting bracket. This bracket may be loosened and re-positioned on the mast to fit the installation scheme and mounting bracket positioning.
3. Ensure the vehicle-mount sensor connector is in close proximity to the mast's mounting bracket location (refer to the vehicle-mount sensor connector section below). Mark and drill the appropriate mounting bracket holes. Be sure to allow for sufficient structural backing, to adequately support the mast and sensor.
4. External sensor cabling is intended to freely hang along the side of the mast. This assures the mast's easy extension and retraction without pinching, crimping, or cutting the sensor cable. Users may tie-wrap the cable to the lower portion of the mast to keep it from flagging in the wind. The external sensor cable has a male connector that couples to the vehicle-mount female connector on the side of the vehicle.
5. Extending the mast. At the top of the nested mast there is a large textured locking ring which loosens and tightens the mast extension. A counter-clockwise rotation loosens the ring and allows the mast to be fully extended. Clockwise ring rotation tightens the extension in place.

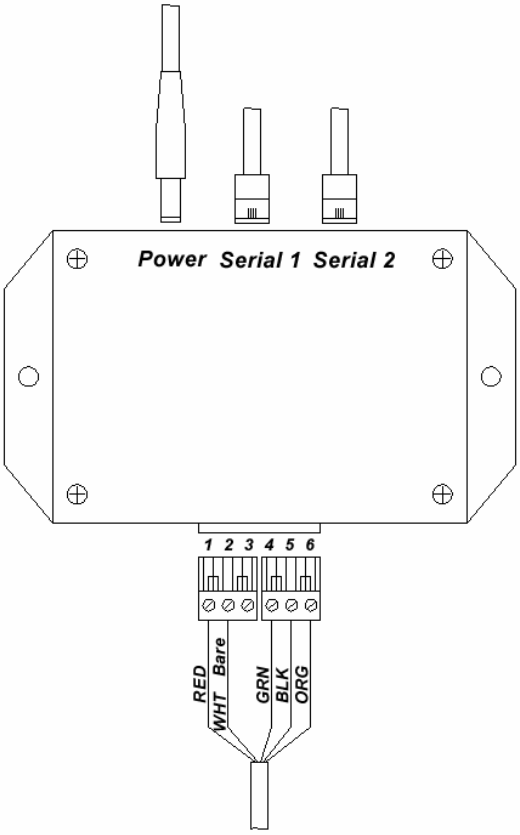
Installing the vehicle mount sensor connector and routing cable

1. To install the female vehicle-mount sensor connector, drill a ¾" hole in close proximity to the sensor mast mounting bracket installation. A recommended location is near the mast's lower base bracket.
2. Drill four small pilot holes for the mounting screws.
3. Run 25-ft cable through the hole and route to the Orion Interface Module location.
4. Connect the cable to the 3-position connectors, as listed in the chart below.
5. Affix the connector with mounting screws on the external side of the vehicle and ensure the associated all-weather connector cap is securely attached.

Installing the Interface Module

Using a #1 Straight Slot screwdriver, attach the wires from the end of the sensor cable to the terminal block screws on the Interface Module as follows:

Terminal Number	Signal	Color
1	+12 V	RED
2	Ground	White and Bare
3	No Connection	
4	Signal Ground	Green
5	RX	Black
6	TX	Orange



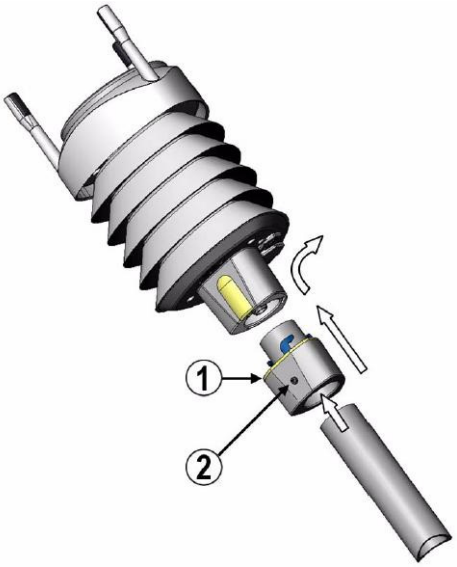
Connecting the Weather Display Console and Computer

Connect the Weather Display Console to the Orion Interface Module using the RJ-11 cable. The Display Console can be connected to either serial port 1 or 2

Connect the Orion Interface Module to the computer using the RJ-11 and DB-9 connector (RS-232 Interface). The computer can be connected to either serial port 1 or 2. On the computer end, the DB-9 connector is plugged into the computer serial port (normally COM port 1). If the computer does not have a serial port, then a USB to Serial Port converter will be needed.

Installing the sensor transmitter and North Orientation

Installing the Mounting Adapter



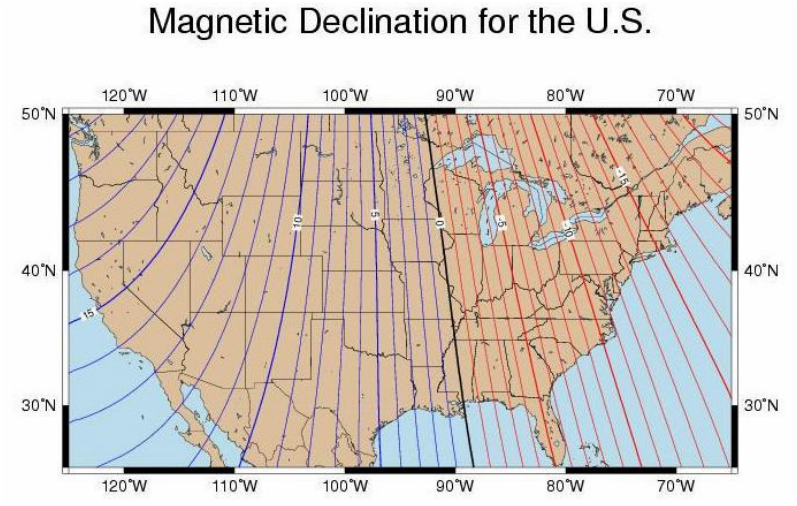
NOTE: The sensor transmitter must be installed to an upright, vertical position.

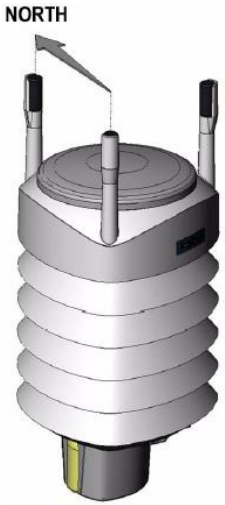
1. Insert the telescoping mast sleeve adapter by screwing it into the threaded portion atop the mast extension.
2. Insert the mounting adapter ① in the transmitter lower side as shown in the diagram above.
3. Turn the adapter firmly until you feel that it has snapped into the locked position.
4. Align the transmitter in such a way that the arrow (on the underside of the transmitter) points to the front of the vehicle (see North Alignment).
5. Tighten the Allen screw ② to firmly and permanently fix the adapter firmly to the sleeve adapter.

North Alignment

North Orientation. Locate the alignment arrow and text **North** on the underside of the transmitter. With the mast mounted on the vehicle, extend the mast to its fullest extension. Before tightening the mast into place, use the field compass provided to orient the transmitter in such a manner that the alignment arrow points to Magnetic North. Rotate the mast extension until the sensor is properly oriented. Tighten the locking nut.

Wind direction can refer to either **Magnetic North**, which is read with a magnetic compass, or **True North**, which uses the earth's geographic meridians. The magnetic declination is the difference in degrees between the true north and magnetic north.





1. If the sensor transmitter is already mounted, loosen the fixing screw on the mounting adapter.
2. Use a compass to determine that the transducer heads are exactly in line with the compass and that the arrow on the bottom of the transmitter points to north.
3. Tighten the fixing screw on the mounting adapter when done.

Once the sensor transmitter is aligned to north, the transmitter can be removed from the mounting adapter without loosing the north orientation.

Section 4: Operation

Communication Settings

The protocol for both serial ports is the following:

Bits per Second (baud rate): 9600

Data bits: 8

Parity: None

Stop bits: 1

Flow control: None

Weather software

Once an RS-232 connection is made between the computer and the Orion Interface Module and the Orion Data Manager is installed, commands can be issued to the weather station using a "Terminal" software such as Hyper Terminal (available with Windows operating system) over the virtual port created by the Data Manager.

The protocol is 8-bit, no parity, 1 stop bit and 9600 baud. All commands must be entered using upper case letters and followed by a carriage return.

The weather station will return "ok" after the results of each command. If the command is incorrect, the weather station will return "?".

The Orion Weather Station is also compatible with WeatherMaster 2000 software and other third party weather software.

Terminal Commands

The following is a description of the commands available using a terminal program such as Hyper Terminal to communicate with the Orion Weather Station. Please note that the Orion Data Manager needs to be installed on the computer before this interface is available.

Displaying current sensor readings

SAMPLE: This command is used to display the current sensor readings in a one line record format (the same format as the datalog). The record starts with the letter S followed by the date and time of the sample, followed by the sensor values and ends with a check sum value. All of these fields are comma delimited.

Example:

S,02/11/98,11:09,36WD,003WS,00.06R,072RH,29.88P1,+050.59T1,+070.77T2,+068.23T3,+064.60T4,04.43LW,0.00X1,0.00X2,6007ok

Where, WD is wind direction, WS is wind speed in MPH, R is rain fall in inches, RH is relative humidity percentage, P1 is barometric pressure in Inches-Hg, T1 is air temperature in degrees F. T2 through T4 are not used, LW, X1 and X2 are also not used.

Wind direction is displayed in a 64 degree compass or 360 degree compass.

If the software is set to the 360 degree setting, wind direction is reported in degrees (1 = 1).

If the software is set to the 64 degree setting, then 1 = 5.625 degrees. For example:

	Degrees	
0	N	0
4	NNE	22.5
8	NE	45
12	ENE	67.5
16	E	90
20	ESE	112.5
24	SE	135
28	SSE	157.5
32	S	180
36	SSW	202.5
40	SW	225
44	WSW	247.5
48	W	270
52	WNW	292.5
56	NW	315
60	NNW	337.5

Continuous display of weather information

1 XFER: This command continuously displays a Sample record every 15 seconds and wind speed and direction every one second. The wind speed and direction record starts with the letter W followed by three digits for wind speed in MPH followed by two digits for wind direction.

Example:

W00124

S,02/11/98,17:44,24WD,001WS,00.08R,085RH,29.82P1,+048.56T1,+070.85T2,+067.24T3,+065.0
8T4,01.74LW,0.00X1,0.00X2,6014

W00224

W00224

W00124

W00124

W00124

W00120okok

An <Esc> followed by a carriage return terminates this command.

XSET: This command defines the frequency the Sample record is displayed in the XFER output. The default frequency of the Sample record in the XFER output is 15 seconds. This frequency can be changed using the XSET command. For example, 60 XSET will cause the Sample record to be issued every 60 seconds. XSET will change the frequency of the XFER output on both serial ports.

CONT: This command will continuously output the Sample record at a specified interval. For example, 5 CONT will output a Sample record every 5 seconds. The time interval is limited to a range of 1 to 16 seconds.

S,05/01/99,09:44,40WD,000WS,00.00R,022RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4923

S,05/01/99,09:44,40WD,000WS,00.00R,023RH,29.09P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4932

S,05/01/99,09:44,40WD,000WS,00.00R,023RH,29.09P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4932

S,05/01/99,09:44,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4924

S,05/01/99,09:45,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4925

S,05/01/99,09:45,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4925

S,05/01/99,09:45,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4925

S,05/01/99,09:45,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4925

S,05/01/99,09:46,40WD,000WS,00.00R,023RH,29.10P1,+070.72T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4928

S,05/01/99,09:46,40WD,000WS,00.00R,023RH,29.10P1,+070.72T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4928okok

An <Esc> followed by a carriage return terminates this command. The output will stop after one more Sample record is issued. For example, if CONT is set to repeat the Sample record every 15 seconds (15 CONT) and an <ESC><RETURN> was entered, one more Sample record will be issued before the double ok is displayed indicating that the command is terminated.

SECTION 5: CALIBRATION

Calibrating the Barometric Pressure Sensor

Altitude Setting

After calibration at the factory, the altitude is set to zero. To get an accurate barometric pressure reading, the local altitude needs to be set in the weather software and the display console.

To set the altitude, use the ALT command and enter the altitude in feet. Please refer to Section 4: Operation for more information. The altitude can also be set using weather software or display console. Please refer to the product user manual.

Optional Calibration Procedure

Even though the barometric pressure sensor is calibrated at the factory, the sensor can be calibrated on-site. This might be required if the weather station needs to match a local source.

To calibrate the barometric pressure on-site:

Using a terminal program enter the elevation using the ALT command.

Set the barometric pressure offset to zero by entering: 0 BAR-OFFSET

Wait approximately 5 seconds, and then take a pressure reading using the SAMPLE command.

Record the barometric pressure from a local reliable source at the same elevation as the sensor transmitter.

Calculate the barometric pressure offset as follows:

Barometric Pressure Offset = Source Reading – Orion Reading.

Enter the barometric pressure offset in 1/100 of in.Hg using the BAR-OFFSET command.

Calibrating the Temperature Sensors

Even though the temperature sensor is calibrated at the factory to ±0.5° F and requires no further calibration, the sensor reading can be adjusted using the TCAL1 command.

Using a terminal program enter a temperature offset using the TCAL1 command. For example, if you would like to increase the temperature reading by 0.5° F, enter 50 TCAL1 and if you want to decrease the reading by 0.5° F, enter -50 TCAL1.

SECTION 6: MAINTENANCE

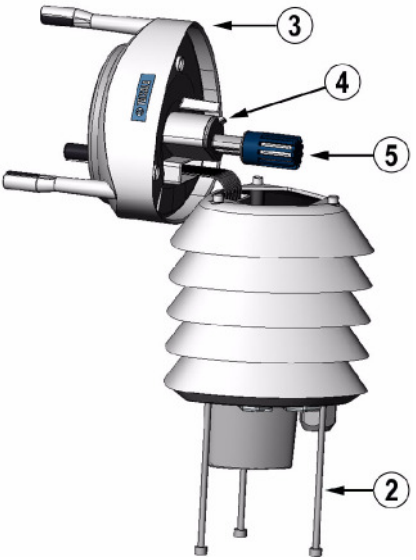
This chapter contains instructions for the basic maintenance of sensor transmitter.

Cleaning

To ensure the accuracy of measurement results, the sensor transmitter should be cleaned when it gets contaminated. Leaves and other such particles should be removed from the precipitation sensor and the transmitter should be cleaned carefully with a soft, lint-free cloth moistened with mild detergent.

Replacing the PTU Module

1. Turn the power off.
2. Loosen the three screws at the bottom of the transmitter.
3. Pull out the top of the transmitter.
4. Release the small white flap and remove the PTU module.
5. Connect a new PTU module (Catalog no. 9581), replace the top and tighten the three bottom screws.
6. Turn the power on.



Factory Calibration and Repair Service

Send the device to Columbia Weather Systems, Inc. for calibration and adjustment, see Section 8: USER SUPPORT INFORMATION for more information.

Section 7: Troubleshooting

This chapter describes common problems, their probable causes and remedies.

Problem	Possible Cause	Action
Wind measurement failure. Both the speed and direction sensors are not reporting correct data	Blockage (trash, leaves, branches, bird nests) between the wind transducers. Check that the wind transducers are not damaged.	Remove the blockage.
Pressure, humidity or temperature measurement failure.	PTU module may not be properly connected. There may be water in the PTU module.	Ensure the proper connection of the PTU module. Remove and dry the module.

SECTION 8: USER SUPPORT INFORMATION

This section consists of the following items:

1. One-Year Limited Warranty: Please read this document carefully.
2. Return for Repair Procedure: This procedure is for your convenience in the event you must return your Orion for repair or replacement. Follow the packing instructions carefully to protect your instrument in transit.

Limited Warranty

Columbia Weather Systems, Inc. (CWS), warrants the Orion 510 Weather Station to be free from defects in materials and/or workmanship when operated in accordance with the manufacturer's operating instructions, for one (1) years from date of purchase, subject to the provisions contained herein. CWS warranty shall extend to the original purchaser only and shall be limited to factory repair or replacement of defective parts.

EXCLUSIONS

Certain parts are not manufactured by CWS (i.e., certain purchased options, etc.) and are therefore not covered by this warranty. These parts may be covered by warranties issued by their respective manufacturers and although CWS will not warrant these parts, CWS will act as agent for the administration of any such independent warranties during the term of this warranty. This warranty does not cover normal maintenance, damage resulting from improper use or repair, or abuse by the operator. Damage caused by lightning or other electrical discharge is specifically excluded. This warranty extends only to repair or replacement, and shall in no event extend to consequential damages. In the event of operator repair or replacement, this warranty shall cover neither the advisability of the repair undertaken, nor the sufficiency of the repair itself.

THIS DOCUMENT REFLECTS THE ENTIRE AND EXCLUSIVE UNDERSTANDING OF THE PARTIES, AND EXCEPT AS OTHERWISE PROVIDED HEREIN, ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, PARTICULARLY THE WARRANTIES OF MERCHANT

ABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Return for Repair Procedure

1. In the event of defects or damage to your unit, first call the Service Department Monday through Friday, 8:30 am to 4:00 pm PST, (503) 629-0887 to determine the advisability of factory repair. The Service Depatment will issue an RMA number (Return Merchandise Authorization) to help us identify the package when received. Please place that number on the outside of the box.
2. In the event factory service is required, return your Orion Weather Station as follows:

   A. Packing

   - Wrap the Sensor Transmitter in a plastic bag first.
   - Pack in original shipping carton or a sturdy oversized carton.
   - Use plenty of packing material.

   B. Include:

   - A brief description of the problem with all known symptoms.
   - Your phone number.
   - Your return street shipping address (UPS will not deliver to a P.O. box).
   - Write the RMA number on the outside of the box.

   C. Shipping

   - Send freight prepaid (UPS recommended).
   - Insurance is recommended. (The factory can provide the current replacement value of the item being shipped for insurance purposes.)

D. Send to:

Columbia Weather Systems, Inc.
2240 NE Griffin Oaks Street, Suite 100
Hillsboro, Oregon 97124

E. C.O.D. shipments will not be accepted.

3. If your unit is under warranty, after repair or replacement has been completed, it will be returned by a carrier and method chosen by Columbia Weather, Inc. to any destination within the continental U.S.A. If you desire some other specific form of conveyance or if you are located beyond these borders, then you must bear the additional cost of return shipment.

4. If your unit is not under warranty, we will call you with an estimate of the charges. If approved, your repaired unit will be returned after all charges, including parts, labor and return shipping and handling, have been paid. If not approved, your unit will be returned as is via UPS COD for the amount of the UPS COD freight charges.

Reference

Glossary

Aspirating Radiation Shield

A device used to shield a sensor such as a temperature probe from direct and indirect radiation and rain while providing access for ventilation.

Barometric Pressure

The pressure exerted by the atmosphere as a consequence of gravitational attraction exerted upon the “column” of air lying directly above the point in question.

Celsius Temperature Scale

A temperature scale with the ice point at 0 degrees and the boiling point of water at 100 degrees.

Dew Point

The temperature to which a given parcel of air must be cooled at constant pressure and constant water-vapor content in order for saturation to occur. When this temperature is below 0°C, it is sometimes called the frost point.

Fahrenheit Temperature Scale

A temperature scale with the ice point at 32 degrees and the boiling point of water at 212 degrees.

Heat Index

The heat index or apparent temperature is a measure of discomfort due to the combination of heat and high humidity. It was developed in 1979 and is based on studies of evaporative skin cooling for combinations of temperature and humidity.

Relative Humidity

Popularly called humidity. The ratio of the actual vapor pressure of the air to the saturation vapor pressure.

Sea Level Pressure

The atmospheric pressure at mean sea level, either directly measured or, most commonly, empirically determined from the observed station pressure.

In regions where the earths surface pressure is above sea level, it is standard observational practice to reduce the observed surface pressure to the value that would exist at a point at sea level directly below.

Wind Chill

That part of the total cooling of a body caused by air motion.

Unit Conversion

Speed

Kilometers per hour = 1.610 x miles per hour

Knots = 0.869 x miles per hour

Meters per second = 0.448 x miles per hour

Feet per second = 1.467 x miles per hour

Temperature

Temperature in °C = 5/9 (temperature in °F - 32)

Temperature in °F = (1.8 x temperature in °C) + 32

Distance

Millimeters = 25.4 x inches

Pressure

Millibars = 33.86 x inches of mercury

Kilopascals = 3.386 x inches of mercury

Pounds per square inch = 0.49 x inches of mercury

Standard atmospheres = 0.0334 x inches of mercury

Tables and Formulas

Wind Chill Chart

	Temperature in °F														
Wind (MPH)	70	60	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60	-70
5	69	58	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68	-78
10	65	53	41	28	16	4	-9	-21	-33	-46	-58	-70	-82	-95	-107
15	63	49	36	22	9	-4	-18	-31	-45	-58	-72	-85	-98	-112	-125
20	61	47	33	18	4	-10	-24	-39	-53	-67	-81	-95	-110	-124	-138
25	60	45	30	15	1	-14	-29	-44	-59	-73	-88	-103	-118	-133	-147
30	59	44	28	13	-2	-17	-32	-48	-63	-78	-93	-109	-124	-139	-154
35	58	43	27	12	-4	-19	-35	-51	-66	-82	-97	-113	-128	-144	-159
40	58	42	26	10	-5	-21	-37	-53	-68	-84	-100	-116	-131	-147	-163
45	57	42	26	10	-6	-22	-38	-54	-70	-86	-101	-117	-133	-149	-165
50	57	41	25	9	-7	-23	-39	-55	-71	-86	-102	-118	-134	-150	-166
55	57	41	25	9	-7	-23	-39	-55	-71	-87	-103	-119	-135	-151	-167
60	57	41	25	9	-7	-23	-39	-55	-71	-87	-102	-118	-134	-150	-166
65	57	41	26	10	-6	-22	-38	-54	-70	-86	-102	-118	-134	-149	-165
70	58	42	26	10	-6	-21	-37	-53	-69	-85	-101	-116	-132	-148	-164

Wind Chill Equation

WC = 91.4 - ((0.474677 - (0.020425 * V) + (0.303107 * SQRT(V))) * (91.4-T))

Where:

WC = wind chill temperature

V = wind velocity in mph

T = air temperature in °F

Heat Index

	Temperature in °F													
RH	70	75	80	85	90	95	100	105	110	115	120	125	130	135
0	64	66	73	78	83	87	91	95	99	103	107	111	117	120
5	64	69	74	79	84	88	93	97	102	107	111	116	122	126
10	65	70	75	80	85	90	95	100	105	111	116	123	131	
15	65	71	76	81	86	91	97	102	108	115	123	131		
20	66	72	77	82	87	93	99	105	112	120	130	141		
25	66	72	77	83	88	94	101	109	117	127	139			
30	67	73	78	84	90	96	104	113	123	135	148			
35	67	73	79	85	91	98	107	118	130	143				
40	68	74	79	86	93	101	110	123	137	151				
45	68	74	80	87	95	104	115	129	143					
50	69	75	81	88	96	107	120	135	150					
55	69	75	81	89	98	110	126	142						
60	70	76	82	90	100	114	132	149						
65	70	76	83	91	102	119	138							
70	70	77	84	93	106	124	144							
75	70	77	85	95	109	130	150							
80	71	78	86	97	113	136								
85	71	78	87	99	117	140								
90	71	79	88	102	122	150								
95	71	79	89	105	126									
100	72	80	90	108	131									

Dew Point

B = (ln (RH/100) + ((17.2694*T) / (238.3+T))) / 17.2694

Dew Point in ℃ = (238.3 * B) / (1-B)

Where:

RH = Relative Humidity

T = Temperature in ℃

Ln = Natural logarithm

Columbia Weather Systems, Inc.

2240 NE Griffin Oaks Street, Suite 100

Hillsboro, OR 97124-6463

Telephone
(503) 629-0887

Fax
(503) 629-0898

Web Site
http://www.columbiaweather.com

Email
info@columbiaweather.com

Version 1.02

Printed in U.S.A.